New 1D and 2D Detectors for Synchrotron Radiation Research

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Pixel-array detectors offer great benefits for many areas of synchrotron research, including positional information and processing ultrahigh countrates in the GHz range. Two types of next-generation pixel detectors will be discussed: (1) A 2D pixel array for detecting electrons or soft x-rays as amplified by a microchannel plate. This detector extends a 1D version currently being completed at LBNL, and will have GHz countrate capability for angle-resolved photoemission and photon in-photon out spectroscopies. Its key element is a custom CMOS IC with charge collection pads, amplifiers, counters and readout logic in pixels of roughly 50 x 50 microns. (2) Photodiode arrays attached to CMOS chips for detecting harder x-rays with good energy and position resolution at ultra-high count-rates, with applications including x-ray absorption spectroscopy, x-ray fluorescence holography, and new types of x-ray diffraction experiments. Each pixel will include a high-rate amplifier and an ADC. Asynchronous hits consisting of a geographical address, a time stamp, and the ADC value will be read out through a data-driven architecture.
Finally, a 1D (eventually 2D) detector for photon correlation spectroscopy will be described. The initial detector would consist of a linear array of 50 microns strips coupled to readout with time autocorrelation at the MHz scale for each strip. A future 2D version would utilize autocorrelators at the pixel level.